Investigation of tsunami disasters using lake Kitagata sediment

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Tsunami disaster after the Tohoku Earthquake that occurred in 2011 increased our concern tsunami in the Japan Sea side of the coastal region as well as the Pacific side. We can find the description of large scale tsunami disaster occurred in the Sea of Japan side in historical documents. In this study, we investigated the tsunami disaster along the Japan side coast using the sediment core from the lake kitagata, Fukui prefecter. Lake Kitagata is a brackish lake connected to the Sea of Japan.One of the tsunami records occurred in this region is the Tensho tsunami in 1586. This tsunami was described in two Literatures, mentioning that the huge waves overwashed the land. However ,no sedimentological traces of this tsunami has been reported.Possible tsunami sediment layer was found from the depth 170-203cm of the core (KT14-5), which is collected from the point about 2 km island from the sea. The layer shows coarse mineral particle size, increase in the amount of calcium carbonate, decrease in the amount of organic matter and moisture content. A corresponding layer in another core include the shell of sea origin.In addition, diatom assamblage show ,that marine and brackish species were about 70% of the total diatom,while that of a sample 30 cm beneath this layer exhibit freshwater species with about 60 percent of the total diatom species. These lines of observation indicate that this layer is tsunami deposit. ^{14}C dating results in 1404-1474 cal AD for a shell from this layer (196cm) slightly older than, but more or less equivalent to the age of Tensho tsunami. This finding is one of the evidences for a large scale tsunami disaster in the past in Hokuriku region.

Keywords: tsunami, lake sediment, diatom

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An experimental study on salt weathering in cold and dry climate

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To examine the effects of salt weathering on tafoni growth in cold and dry climate like Antarctica and Mars, a laboratory experiment was carried out using two types of rocks (Oya tuff and Aoshima sandstone) and three types of salt solutions (NaCl, Na_2SO_4 and $MgSO_4$). Cubic specimens with a side of 5 cm in length were immersed in each saturated salt solution for 10°C for 72 h. After immersion, specimens were oven-dried at 110°C for 48 h and stored in a desiccator for a month. Then, specimens were subjected to wetting/drying cycles in a cold chamber with humidity change, which ranges from 20 to 100%RH within every 6 hours. Air temperature was kept to 10°C in the cold chamber.
Fine materials with the size of < 2 mm were splitted off from the surface of specimens with salts. The weight reduction of the specimen was largest for the case using NaCl. The decrease in Equo-tip hardness value of specimens with NaCl indicated the reduction of the surface strength. The longitudinal wave velocity of all specimens did not change. Therefore, salt weathering only occurred on the rock surface. The temperature on all specimens increased immediately after humidity increased, and the degree of temperature change was larger for the specimens with NaCl which deliquesces in air with high humidity. These temperature changes might be induced by salt dissolution and deliquescence with water condensation.

Keywords: salt weathering, humidity change, tafoni, Antarctica, Mars

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Biological weathering on the first gallery wall of Angkor Wat temple, Cambodia

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The Angkor complex is mainly constructed in the 9~13th century by Khmer dynasty and was designated as a world cultural heritage by UNESCO in 1992. The Angkor complex represents the entire range of Khmer art and is also famous for large trees growing on the temple wall (Ta Prohm) and various lichens on the stone surfaces. Angkor Wat temple, constructed of sandstone and laterite, is one of the most popular temples in the complex. The French School of Asian Studies (Ecole française d'Extrême-Orient, EFEO) had performed conservation work in early 20th century. However, it was in poor condition after the Cambodian civil war. During the period of 1986 to 1993, Archaeological Survey of India (ASI) contributed to the Angkor Wat's conservation including reconstruction of the building itself, replacement of blocks, and removal of vegetation. After completion of the cleaning procedures (nearly 200,000 m^2) by ASI, the original color, gray to yellowish brown, of the Angkor Wat sandstone was restored. However, after two years, cyanobacteria have colonized large portions of the surface of Angkor Wat temple. We categorized surface of the first gallery wall into four types: 1) area covered by cyanobacteria; 2) un-covered area; 3) exfoliated area; and 4) re-covered area after peeling off. We measure the hardness of the first gallery wall by Schmidt rock hammer. Average rebound value of exfoliated area is 3.7 times higher than cyanobacteria covered area. In Un-covered area, it is 3.6 times higher than cyanobacteria covered area. Cyanobacteria are not protecting the wall surface but are accelerating its weathering by reducing surface hardness. However, it is hard to remove clearly and will be easily covered again.

Keywords: Angkor Wat temple, Biological weathering, Cyanobacteria, Cultural heritage

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Burial history of the Gonghe Basin, northeastern Tibet, constrained by in situ cosmogenic radionuclides

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Tibetan plateau has been growing up and expanding its area laterally due to the collision between Indian and Eurasian Plates. The marginal deformation of the plateau related to the lateral growth formed many mountain ranges and inter-mountain basins surrounding the plateau. Understanding development and sedimentation histories of them is an important key for revealing the growing process of the northeastern plateau. Gonghe Basin, one of the inter-mountain basins at the northeastern margin of the plateau, is located about 3200 m above the sea level and bordered by Qinghai Nan Shan and Heka Shan on the north and south, respectively. Previous researches reported that after the Yellow River filled the basin with over 500 m thick clastic sediments, the river has been cutting down through the sediments and formed many fluvial terraces. In order to reveal the process, we applied detailed geomorphological mapping, and surface exposure and burial dating by using in situ cosmogenic radionuclides (CRNs). In this presentation, we will mainly introduce burial ages of the basin sediment and their implications for early stage of development of the basin.
For cosmogenic burial dating, quarts pebbles in the basin fill were collected from the nine sampling sites locating every 50 m depth in the valley. As ^{10}Be and ^{26}Al have different decay constant, ^{26}Al/^{10}Be-ratio yield the time elapsed since shielded from cosmic rays. Calculated burial ages are in remarkable stratigraphic order from top to bottom of the fill. Each of the deposition rates determined from the burial ages are almost the same deposition rate of about 70 mm/kyr. This indicates that the basin had been constantly filled since the late Miocene. In the presentation we will also discuss an effect of constant deposition on burial ages and rejuvenation resulted from down cutting of the Yelliow River.

Keywords: Tibetan Plateau, Gonghe Basin, cosmogenic radionuclide, burial age

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Detection of landslide surface deformation around Dhunche, Trishuli River watershed in Nepal using time-series InSAR images

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Dhunche in Trishuli River watershed, Nepal is the town (ca. 3,000m in elevation) that is located 46km north from Kathumandu, where is in the transition area from lesser Himalaya to High Himalaya. The Gorkha earthquake-induced landslides were concentrated around the town, there is the risk that heavy rains in monsoon seasons will reactivate such the landslides. Therefore, continuous monitoring of slight deformation by landslides is important to prevent disasters. In this study I used Advanced Land Observing Satellite-2 (ALOS-2)/Phased Array L-band Synthetic Aperture Radar-2 (PALSAR-2) observed before and after the earthquake, 21 Feb 2015 and 2 May, in the monsoon season of 25 Jul and 22 Aug, and in the late monsoon season of 22 Aug and 3 Oct, and produced SAR interferograms using RINC 0.47 software (Ozawa 2014). By interpreting these InSAR images, I found that there are (1) landslides slightly deformed by the earhquake and continuously and slightly deformed, (2) landslides which was not deformed by the earthquake but continuously and slightly deformed. These knowledges are thought to be basic materials to map hazard of future landslides.
PALSAR-2 data used in this study were provided by JAXA in the framework of special collaborative research (B) “Surface deformation study using a new generation SAR” by Earthquake Research Institute, the University of Tokyo. This study was also supported by "the Nepal Earthquake and Hazard Mapping of Future Landslides for Making the Plan of Better Reconstruction” (Principal investigator, Prof. Chigira) related to the April 2015 Nepal earthquake in the J-RAPID Program by Japan Science and Technology Agency (JST).
* Reference
Ozawa T (2014) Development of InSAR processing tools in NIED -Part 3-. Proceedings of Japan Geoscience Union Meeting 2014 STT59-P12. http://www2.jpgu.org/meeting/2014/session/S-TT59.html

Keywords: SAR, Landslide, Nepal, Earthquake, Monsoon

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Orogens and global landform, revisited through an analysis of digital elevation model

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This presentation shows statistical relationship between the ages of continental crust and two topographical parameters: elevation and relief both of which derived from a global DEM (Figures 1 and 2). Although the term “orogeny” is tricky because different meanings are put on by different researchers, if we accept the definition that the orogeny is processes growing upper continental crusts along the convergent boundaries of plates, megascale landform is primarily explained by isostatic uplift and following erosion. From this point of view, reeducation is required for geography teachers in Japanese high schools, because they are largely confused about orogeny and orogens.

Keywords: Orogen, Megascale landform, Digital elevation model (DEM), Geographic education

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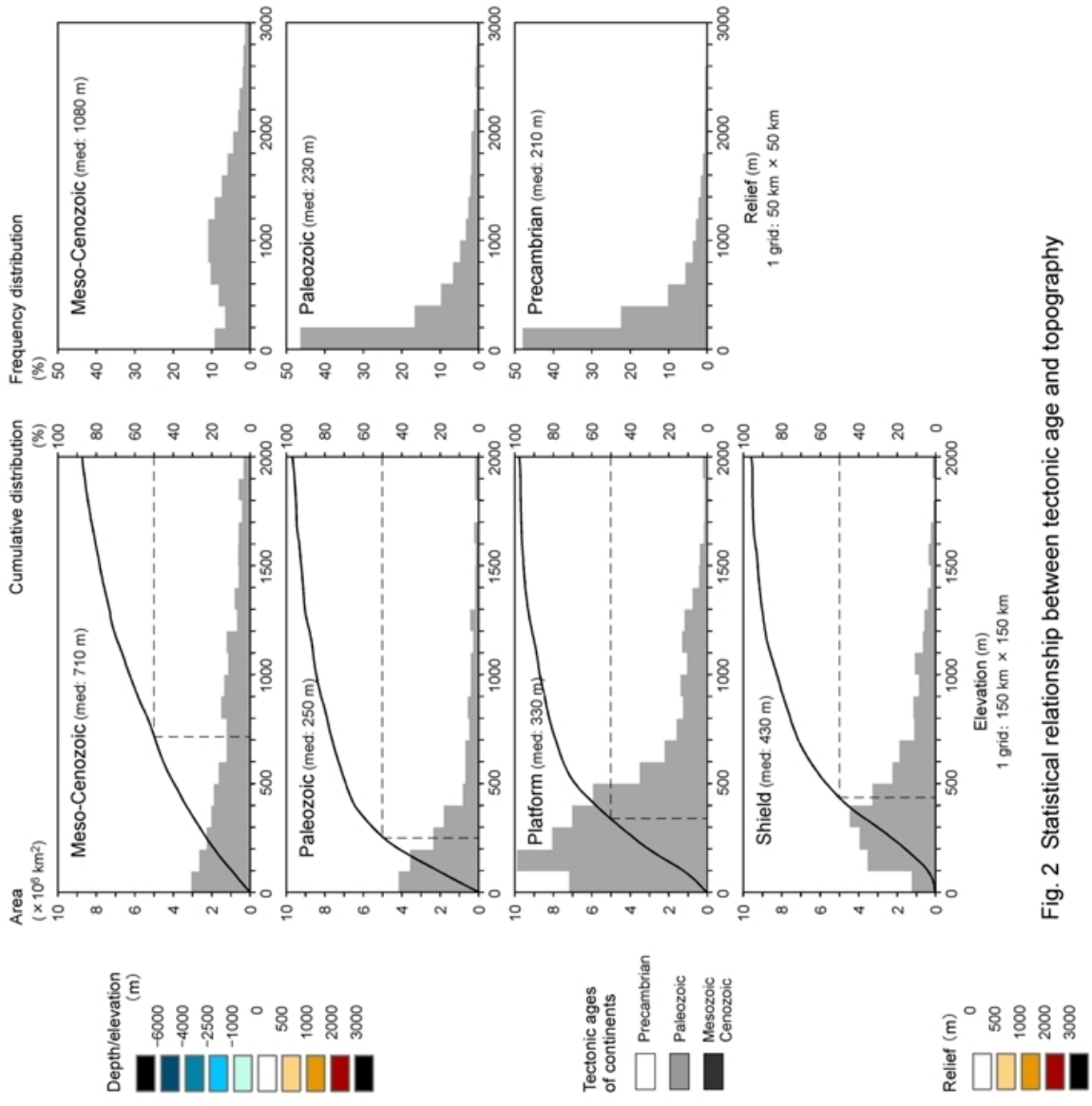

Fig. 2 Statistical relationship between tectonic age and topography

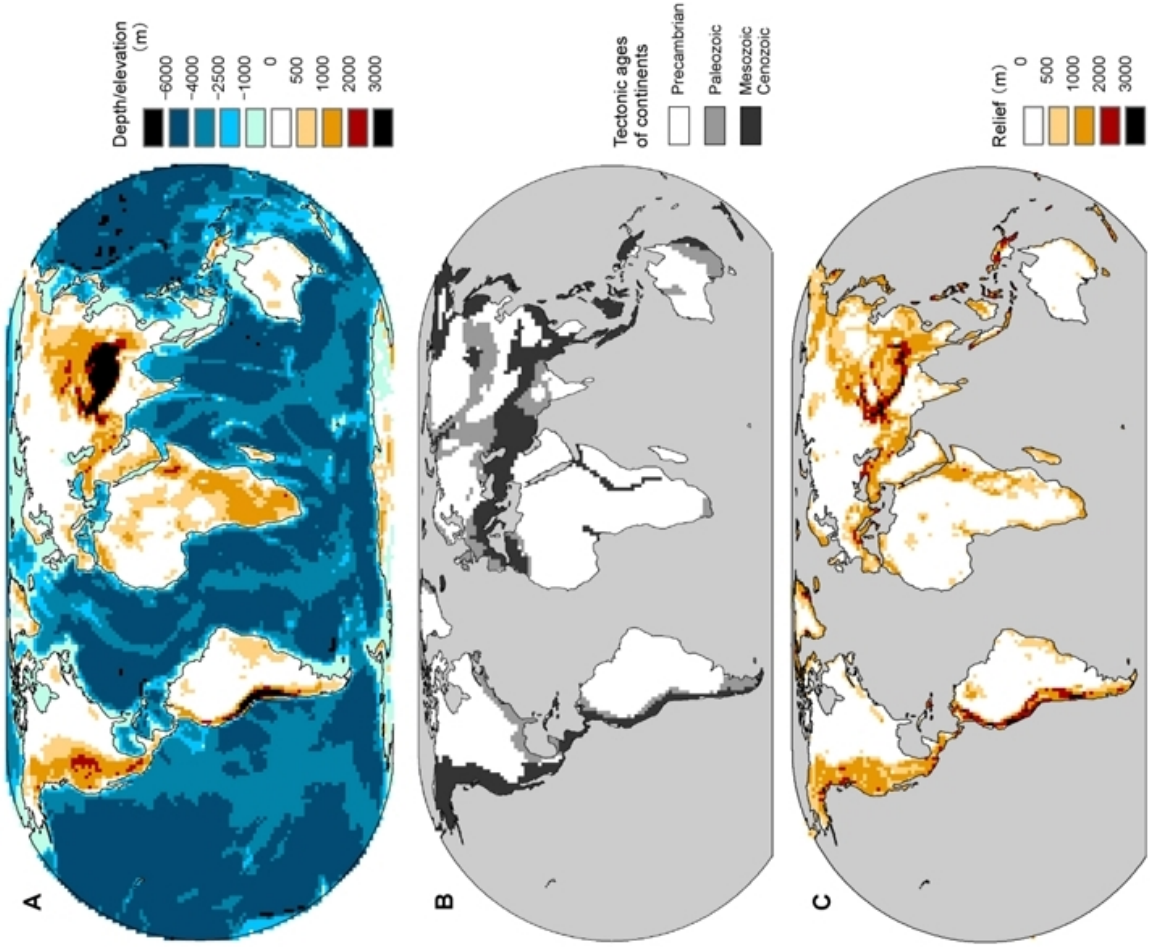

Fig. 1 Global elevation (A), tectonic ages (B) and relief (C).
A grid size is 150 km × 150 km.

Data source:
Amante, C. and Eakins, B.W. (2009) ETOPO1 1 Arc-Minute Global Relief Model: Procedures, Data Sources and Analysis, NOAA Technical Memorandum NESDIS NGDC-24.
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Relationships between rainfall, fluctuation of water level and landform changes in the upper reaches of the River Azusa, central Japan

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The upper reaches of the River Azusa in central Japan is a gravel-bed braided river flowing down the Northern Japan Alps. In this reaches landforms of the riverbed change yearly or once a couple of years. This study aims to clarify the relationships between rainfall, water level fluctuation and landform changes. The observation using interval shooting cameras has carried out since July, 2011. These have taken the images of the riverbed and recorded the conditions in every 15 or 20 minutes. The results are as follows. Despite relatively large drainage basin rainfall-runoff response is quite fast. About 30 minutes after the start of a rainfall the water level began to rise. The amount of the water level rise to the rainfall was different when the rainfall event occurred. During the Baiu rainy season the relatively less rainfall caused larger water level rise than after the end of the Baiu. Only one major landform change event was recorded during the observation. It occurred on 19 June, 2013. The heavy rain recorded 166 mm of the daily rainfall caused bankfull discharge, which was about 1 meter water level rise. These relationships between rainfall, water level rise and landform changes was caused by the geomorphological characteristics of the Kamikochi valley, which has thick gravel deposits more than several tens of meters and their water storage characteristics.

Keywords: rainfall-runoff, water level fluctuation, landform change, intervel shooting camera, upper Azusa River, Kamikochi

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Hydraulic conditions of erosion and crevasse spray sedimentation generated by the breach of Kinugawa River around Misaka area, Joso City on September 10, 2015.

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When flooding occurs in the large rivers, the special terrain is generated around the breach point. First of all, it scraped deep flood flow the marsh, making erosion terrain called crevasse channel. The crevasse spray deposits are around the channel. Especially crevasse spray deposits have been frequently reported in the fluvial sediments of geologic era, however modern sedimentological and geomorphological report is limited yet.
Through September 9 to 11, 2015, large flooding and landslides disaster around the East Japan was generated by the influence of the Typhoon No. 18, named "2015 Kanto and Tohoku heavy rain disaster.". The left bank of Kinu River was breached over a period of about 200 m, a large flooding disaster occurred on 10 September 10 around 12:50 in Misaka area in Joso City, Ibaraki Prefecture. Various sedimentary structures were observed, such as heavy erosional terrain caused by the supercritical flow around the breach point, the bed form 3D dune-ripple control by the changing flow velocity in the crevasse spray deposits, and fabric of rubbles indicating flow direction.

Keywords: crevasse spray, Kinu River, Misaka area, Joso City, hydraulic condition, Geomorphology, Sedimentology

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Wind duct experiments on reptation particle motions using a high speed video camera

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Aeolian reptating particles, splash particles by saltating grain collision to bed, were surveyed with wind duct (width: 9 cm, depth: 56 cm, lengh: 7 m28 cm), using high speed video camera (Sony, NEX-FS700R /FS700RH). 3.8 mm diameter particles of polypropylene (specific gravity: 0.9) were selected for experimental material in order to trace particle motion tracks easier. The video camera, which was set aside in the center part of the wind duct, recorded 960 frames per second. Polypropylene particles were laid at 24cm thickness. Wind condition was constant: 18 m/s. From 40 particle motion tracks, we analyzed grain speeds, accelerations and jumping heights. Most saltating particle showed more than 100 cm/s in speed and repetitions between accelerations during jumping stage and rapid decelerations after hitting the bed. While reptating particles showed less than 50 cm/s in speed and less accelerations and decelerations. Jumping heights of particles were clue to distinguish between reptation and saltation. In this experimental, if jumping height exceeds twice the grain diameter, particle shows continuous saltating motion. We had also noticed that creep mode movements, moving only by wind action, were very rare phenomena.

Keywords: aeolian sediment transport mode, saltation, reptation, creep, high speed video camera, particle motion analysis

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Causal connection between denudational and depositional mechanism: an approach based on stream analysis at Eastern Yoro Mountains

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The eastern side of Yoro Mountains presents steep landscape due to active uplifting and associated river incision. As the mountains faces low-lying Holocene river delta, sedimentary deposits yielded in the mountains form alluvial fans at eastern foot of the mountains. Many researchers have described topographic features of alluvial fans, and there are some general empirical agreements about them. For example, it is widely accepted that gradients of fan slope have negative correlation with catchment area. In the other hand, experimental miniature alluvial fans clarified that increase in sediment discharge and decrease in water discharge steepen fan slopes. To verify the effect of sediment discharge in real world, denudation rate of catchments or accumulation rate of alluvial fan should be obtained. Instead of directly measured denudation rates, hillslopes and relief ratio of catchment area were commonly used to discuss the relation. However, independency of denudation rate on hillslopes is reported in steep landscapes of “threshold slope”. Likewise, relief ratio tends to have negative relation with catchment area, thus effect of increasing relief ratio is difficult to separate from that of decreasing catchment area. As another reference, channel steepness is defined based on stream-power incision model and is expected to have positive correlation with incision rate and rock strength. Incision rates of bedrock river, expressible as channel steepness, would control landscape denudation rate in steep mountains. Therefore, this presentation reports channel steepness of the eastern Yoro Mountains and discusses effect of the channel steepness on fan slopes.

Keywords: mountain river, threshold hillslope, denudation, chi plot, fan slope

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Effects of piedmont deposition on the development of experimental erosion landform

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The development experimental landform with rainfall-erosion and uplift is considered to be controlled by various factors, such as rainfall intensity, permeability and strength of material, and the width of deposition area. In order to understand the way of experimental landform development, effects of these factors should be examined individually. The effects of the width of deposition area surrounding the uplifted area (60 x 60 cm square) were examined by comparing runs with different deposition area. Specifications of those runs are listed below. Rainfall intensity are 80-90 mm/h and all runs are in the steady state phase**(Ouchi, 2015).

	deposition area	uplift duration	permeability	uplift rate
run27	10cm	960h	2.94cm/s	0.36mm/h
run32	20cm	1000h	1.84cm/s	0.36mm/h
run30	10cm	1160h	2.99cm/s	0.1mm/h
run31	20cm	1160h	4.68cm/s	0.1mm/h

In the first stage of experiments, fluvial erosion with the development of valley systems dominates in the uplifted area, and in the deposition area sediments deposit to form alluvial fans with frequently shifting the place of deposition. Sections of alluvial fans observed after the experiments reveal that those alluvial fans advance with keeping nearly constant gradient of deposition surface. After alluvial fans fill the area of deposition, the area becomes the area of transport and this accelerates fluvial erosion in the uplifted area. Valley incision into the uplifted area increases the area of slopes and as aresult promotes slope failures. Slope failures occur frequently and dominate the landform change after relief reaches a certain height. Channels become conduits of sediments produced by slope failures, and the average height becomes rather stable. This stable average height indicates the achievement of balance between erosion and uplift height (stady state).

Wider deposition area requires longer time of alluvial fan development to fill the area, and this helps prolonging the period of fluvial erosion and slowing the development of valley systems. Relatively slow valley incision and prolonged period of fluvial erosion allow the uplift increase the height of sand mound. The average height of uplifted area after becoming stable is higher with wider deposition area. The height of fan apex, which determines the base level of erosion in the uplifted area is higher with wider deposition area. After the deposition area turns into the area of transport, landform changes look similar regardless of the width of deposition area. Shapes of longitudinal channel profiles show good similarity despite the difference in deposition area, except for their height and length. Ridges, however, tend to be separated in the run with narrower deposition area, probably because accelerated fluvial erosion during the period of lower relief promotes the development of wide and shallow valleys.

**Ouchi, S. 2015. Experimental landform development by rainfall erosion with uplift at various rates. Geomorphology 238: 68-77.

Keywords: rainfall-erosion experiment, width of deposition area, development of alluvial fans, fluvial erosion, slope failures, uplift rate

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